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AND THE OFFICE
Elizabeth Humphreys
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Technical Study 17
**TECHNOLOGICAL CHANGE
AND THE OFFICE**
Elizabeth Humphreys
July 1981

This is one in a series of technical studies prepared for the Task Force on Labour Market Development. The opinions expressed are those of the author and do not necessarily reflect those of the Task Force. They do not reflect the views of the Government of Canada.

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ABSTRACT

TECHNOLOGICAL CHANGE AND THE OFFICE

Elizabeth Humphreys

This paper is concerned with the potential impact of micro-technology on the work of office employees. The issues addressed include: (1) the level of employment, (2) the retraining and upgrading of skill requirements, (3) the career advancement opportunities and (4) the employment adjustment mechanisms available to reduce the vulnerability of employees to job loss resulting from the introduction of micro-electronic technology into the office. A number of pressing concerns are identified for consideration by policy makers:

- There is an urgent need for funding directed towards research policy and program development concerned with the social and economic impact of micro-electronic technology.
- The development of more adequate data bases and forecasting models must be given higher priority.
- Additional resources should be directed at rectifying the shortage of high-level, skilled people in systems, computer design and sophisticated software development in Canada.
- Employment counsellors must be aware of the changing skill requirements for office occupations in order to provide effective career counselling.
- Initial training and re-entry training should place more emphasis on raising the basic level of vocational skills and general education to ensure greater adaptability on the part of new labour force entrants.
- Employment adjustment programs must be assessed in light of the changing needs of workers and industry as a consequence of the introduction of micro-electronic technology into the workplace.

- In terms of the anticipated increase in the demand for retraining as a result of technological change, the needs of women merit special attention. This may require the provision of part-time training programs, work orientation courses to familiarize women with a given work setting, or short internships to help them overcome their lack of confidence or information.

SOMMAIRE

L'EVOLUTION TECHNOLOGIQUE ET LE TRAVAIL DE BUREAU

Elizabeth Humphreys

Le document traite des répercussions possibles de la micro-technologie sur le travail des employés de bureau. Les questions analysées comprennent: 1) le niveau d'emploi; 2) le recyclage et le perfectionnement des travailleurs pour répondre aux nouveaux besoins en compétences; 3) les possibilités d'avancement et 4) les mécanismes d'adaptation à l'emploi qui existent pour rendre les employés moins vulnérables aux pertes d'emploi découlant de l'adoption de la technologie micro-électronique dans les bureaux. Le document se termine par l'énumération de problèmes urgents que doivent étudier les décideurs:

- Il est nécessaire d'affecter des fonds à la recherche et à l'élaboration de programmes en vue de déterminer l'impact économique et social de la technologie micro-électronique.
- On doit accorder plus d'importance à l'élaboration de bases de données pertinentes et de modèles de prévisions adéquats.
- Des ressources additionnelles devraient être affectées en vue d'atténuer les pénuries de travailleurs hautement spécialisés du domaine de l'informatique tels les spécialistes en logiciel, les ingénieurs-concepteurs et les analystes fonctionnels.
- Les conseillers en placement doivent être au courant des nouvelles exigences liées au travail de bureau s'ils veulent pouvoir offrir des services efficaces de counselling.
- La formation préparatoire ainsi que la formation visant ceux ou celles qui reviennent sur le marché du travail devraient être orientées vers l'acquisition de compétences professionnelles génériques et de connaissances plus générales pour permettre aux nouveaux actifs de mieux s'adapter et de s'intégrer au marché du travail.
- Les programmes d'adaptation à l'emploi doivent être évalués en fonction des nouveaux besoins des travailleurs et de l'industrie découlant de la prolifération de la micro-technologie sur le marché du travail.

- Pour ce qui est de l'accroissement prévu de la demande de recyclage en raison de changements technologiques, une attention spéciale devrait être accordée aux besoins des femmes. A cet égard, il y aurait lieu d'établir des programmes de formation à temps partiel, des cours de formation axés sur l'emploi pour permettre aux femmes de se familiariser avec un cadre de travail donné, ou encore de courts stages pour aider les femmes à acquérir la confiance et l'information qui leur manquent.

Technological Change and the Office

Introduction

The introduction of microelectronic technology into the office has facilitated the rapid storing and editing of text material and the computerization of office functions associated with cost accounting, auditing, purchasing and sales, inventory, payrolls and personnel. Some computers also have the capability of sending messages between terminals resulting in electronic mail. The office of the future is a concept revolutionary to the development of our society because it has the potential to re-define how a large proportion of Canada's labour force will function.

Microelectronics is seen by many academics and policy makers as the most revolutionary technology of the 20th Century. The most essential element of this technology is the silicon chip; a flake of silicon, or sand, 1/4 of an inch square, on which is etched a network of electronic circuits. While this technology has immediate application in almost every industry, this paper will focus on one sector of the labour force -- office employees. The following discussion will limit itself to a concern with the impact of microelectronic technology on office employees in the Canadian labour force. However, it is important to recognize that the recent and rapid introduction of micro-electronic technology into the labour markets of industrialized countries is having international repercussions:

"The proliferation of (microelectronic technology) amounts to ... an information arms race. There is great and growing competition among firms and governments around the world to develop increasingly advanced microelectronic devices. And their diffusion appears to be happening at a much faster rate than any new technology which has gone before. The implications for economic, political, and social

(Cont'd)

Most research on the impact of microelectronic technology on employment in the service sector supports the conclusion that the rate of increase in demand for services will not be adequate to offset the rate of increase in the productivity of workers in the services sector. The conclusion of these studies is generally that the result will be considerable unemployment in the service sector.

What are some of the perceived benefits of the introduction of microelectronic technology into the office? The most important benefits are seen to derive from a reduction of menial, time consuming, tasks; an improved quality of work; an increase in organizational efficiency, effectiveness and productivity. The technological innovations required to bring about such benefits, however, require a substantial financial investment by management. In order for organizations to realize a significant financial return on this investment, a substantial decline in the cost of labour is required.

During the past decade the productivity of blue collar workers has increased substantially through the application of microelectronic technology. On the other hand, costs of office administration have risen continually while productivity levels have remained relatively constant. The rapid proliferation of microelectronic technology and the decreasing price of this technology have provided the incentive to managers to exercise the option of automating the last bastion of labour intensive work -- the office.

Salaries drawn by employees working in the office (approximately 40% of all workers in the labour force) account for up to 50% of the total overhead costs for corporations. Office costs have approximately doubled over the past decade while office productivity has largely stagnated. This has been the key to the quiet technological revolution: while office employment and overhead costs have soared, the price of microelectronic office equipment has plummeted at an annual rate of 10%, bringing increasingly sophisticated computers into the reach of even small businesses. One of the issues which this phenomenon raised is that of the anticipated affect in the level of employment available to office employees.

I. Employment Impact

As yet there is no consensus in the debate as to the net job creation/job loss effect in the office which may result from the introduction of microelectronic technology. There are estimates, however, that up to 40% of existing office work could be automated. Further, estimates of the projected demand for clerical workers, following the implementation of such computer technology as the word processor, indicate the possibility of the number of clerical jobs in Canada dropping to one-third of the current level within the next decade. However, given the present state of theoretical development and empirical research concerning the impact of micro-electronic technology on employment, Canada, as well as other OECD member countries, is in the unenviable position of being uninformed as to the net employment outcome of technological change. While researchers generally agree on "the benefits of the technology and the inevitability of its application in the industrialized market economy countries", they disagree on "whether the number of jobs created will keep pace with the number of jobs lost" (Zeman, 1979: 248). As Zeman (1979) has observed, "policy makers and researchers are well advised to start the task of separating the facts from the myths by admitting ignorance".

The economic forecasting models which have been developed to take account of the impact of microelectronic technology on employment are generally recognized as inadequate. These models are most often based on the relationship of technology and current employment and the employment structures of the recent past. Microelectronic technology, however, is changing these relationships and structures. Aggregate totals produced by forecasting models generally conceal such changes. More adequate models would require considerable quantitative data on the application of micro-electronic technology in industries and occupations as well as the conditions which affect the rate and extent of its application. At the present time, Canada lacks the necessary data for either macro or micro-economic forecasting models of the impact of micro-electronic technology on employment.

In this context, the question arises as to the possibility of developing a Canadian forecasting model at this point in time:

"The Department of Employment and Immigration has a forecasting model known as the Canadian Forecasting System... . The problem with the COFOR system is that you are confined to a converter matrix which converts employment by industry into occupational demands. You are confined to a matrix that is given for a point in time, and the problem with modelling in this kind of forecasting system is that one wants to capture precisely the changes which take place over time - the interrelationships between occupation and the industry structure - if one is to take technological change into account.

Because the forecasting models are based on mature sectors of the economy, and computers and communications are not a mature sector of the economy - this sector is rapidly growing - the results are not worthwhile. Also the published data tended to conceal rather than reveal what really happened". (Science Council, 1980:54).

Clearly the development of more adequate data bases, as well as forecasting models, must be given higher priority by Canadian government agencies.

While researchers and policy makers are necessarily concerned with the overall employment effects of technological change, they are also interested in examining more specific employment effects such as labour displacement (due to the changing nature of work functions), the specific industrial and occupational sectors in which work functions are most likely to be altered, and the specific segments of the labour force which will be particularly affected by microelectronic technology.

A. Labour Displacement:

Upgrading and Retraining Requirements

While it is important to consider the net job balance resulting from the introduction of microelectronic technology into the office, it is also essential to examine the impact of this technology on the nature of work functions in the office and the training required of workers performing such functions. Even if it is assumed that the introduction of microelectronic technology into the office will create as many jobs as are lost, issues related to the transferability of workers with skills appropriate for one set of work-functions to jobs with a different set of work-functions are critical for policy-makers.

The impact of technological change on job content and the organization of work within the office is subject to considerable debate. The extent of the impact is likely to vary considerably with the nature and structure of the organization, the type of tasks being performed, the nature and stage of the technology, the design of the system and the strategy for implementation. The effects of technological change are neither automatic nor inevitable. In this context, the following considerations should be borne in mind. It is the case that not all jobs will be affected in the same manner - some may be eliminated, some may involve more routine and monotonous work and others more creative work. These different effects may be the result of management decisions as to how the technology is introduced and for what purposes it is used. Also to some extent the effects may be due to the nature of the technology itself in the sense that some equipment may be designed with a specific division of work in mind.

One of the major issues currently under debate is whether, and to what extent, jobs created by the introduction of technological innovations will be more routine and monotonous, and whether such

jobs will require fewer skills. It is generally acknowledged that the answer depends on the degree to which the technology actually performs tasks previously done by employees and how their work is subsequently organized.

A few examples will suffice in demonstrating how this technology may affect the work functions performed by office employees. Computer technology is expected to relieve clerical workers of such routine office tasks as making appointments, recording, storing, and filing information. However, the entry, manipulation, and retrieval of such data from the computer will require support staff as well as staff and line managers to have computer-related skills. While there will no doubt be an increasing demand for software and hardware computer specialists to support and maintain such systems, Canada is currently experiencing a shortage of personnel to perform such work functions. As has been noted in a report by the Science Council (1980: 35) :

"Ironically, even while policy analysts worry about the extent of unemployment and deskilling in the 1980's, there is now and will continue to be a shortage of high-level, skilled people in systems, computer design, and sophisticated software development... . This shortage may be the single greatest impediment to the development of microelectronics, both in Canada and world-wide... . The 'crunch' will really be felt from 1983 to 1985. During this period the demand for microelectronic-based products should be very high, but the people, who are still being trained, will not yet be available for employment".

There is little empirical research available on the magnitude or the nature and length of retraining which will be required as a consequence of the impact of microelectronic technology on the industrial work environment. However, a Canadian study, conducted by Peitchinis (1978: 147), estimated that approximately 60% of workers in the labour force will require some degree of retraining or upgrading as a result of technological change. When the

training requirements of re-entry women and entrants to the labour force are also considered, the magnitude of retraining requirements may be even more staggering.

In terms of the anticipated increase in the demand for re-training, the needs of women merit special attention. The fact that a large proportion of women in the labour force are concentrated in a small range of occupations which are characterized by low or middle-level skill requirements, and the fact that these occupations have been, or will be, profoundly affected by technological changes gives urgency to the question of the retraining of women. The issue is not that only female-dominated occupations are affected but rather that the problems of responding to the need for retraining women are particularly complex as a result of a combination of factors:

"the demand for women to acquire new skills and to be 'redeployable' occupationally and perhaps geographically, when some of the major factors responsible for, or aggravating, the low status of women in the labour market are precisely insufficient education and training, lack of time for additional training and lack of geographical mobility due mainly to family responsibilities and reluctance to invest in women's training because of a perception of their weak attachment to the labour market."
(ILO, 1980:62)

A further consideration related to training is the type and level of programme required. If it is assumed that those individuals in the occupations most affected by technological change will be retrained and redeployed and that natural attrition will facilitate many job reductions, the main effect of changes in skill requirements will be felt by recent entrants to the labour force looking for low-skilled or unskilled work - either school leavers or re-entrants, a majority of the latter being women (ILO, 1980:62). It is these jobs that are most

likely to diminish as technological change becomes increasingly prevalent in the office. As is noted by the ILO (1980:63):

"Initial training and re-entry training ... will need to impart different skills than in the past. More emphasis will have to be placed on raising the basic level of both vocational skills and general education to ensure greater adaptability on the part of new labour force entrants."

The length of training required to obtain the appropriate skills to use such technology as the word processor is estimated to be between three and six months. The time required for acquiring skills for work on computer terminals or with mini-computers cannot be estimated in the aggregate since the skills are largely dependent on the sophistication of the software.

As a result of the introduction of new technology and the subsequent re-organization of work it often entails, some new or up-dated managerial or supervisory skills are often required. Office management, and the organization of secretarial services in particular, are undergoing substantial changes.

"New skills are increasingly required in classification, coding and filing of material; in monitoring the flow of work; in deciding on the appropriate form of text processing, storage and transmission; and in co-ordinating work with other units that share central facilities. Specific jobs of data processing manager or supervisor have been created which require skills in the organization of data entry systems, control and data entry improvement techniques."
(ILO, 1980:64).

Policy issues arising from the preceeding discussion concern the following: 1) what kind and length of training on upgrading programs will be required; 2) what kinds of facilities and resource people are required to offer such programs, and; 3) who will pay the cost of such retraining or upgrading of workers? Will it be government, industry, workers or some combination of the three? To date there has been relatively little research conducted in order to examine these issues. The most extensive Canadian studies available are those authorized by Peitchinis (1978) and the Carrothers Commission (1979).

There can be no doubt but that in the next five years there will be an increasing demand for retraining and upgrading programs for workers affected by microelectronic technology. Retraining and upgrading programs are anticipated to be especially required for individuals currently employed in offices or for individuals who are considering re-entry into the labour force and whose job experience is related to office work. The majority of these individuals are likely to be female and, for those currently employed in offices, are not apt to be affiliated with a union. The latter factor will have consequences for the protection afforded office employees with regard to redundancy and layoffs as well as the availability of company initiated retraining or upgrading programs.

The fact that a significant proportion of the office workers affected by microelectronic technology will be women, requires policy makers who are concerned with issues related to retraining and upgrading programs to pay particular attention to the specific needs of women in order to ensure that both women and men share in an equitable manner both the benefits and the burdens arising from the introduction of microelectronic technology into the office environment.

B. Career Advancement Opportunities

While microelectronic technology will no doubt have a substantial impact on the number of jobs and the nature of work functions in the office, it will also have an affect on the structure of organizational hierarchies and hence opportunities for career advancement. The responsibilities of both managers and supervisors as well as support staff are likely to be radically reorganized in order to maximize the use of labour and capital. The Office Technology Working Party in England, for example, suggests that the role of supervisors and managers will evolve as follows:

"The primary task of managers is to control, direct and implement company policy as laid down by the board and senior management. Their jobs include decision making, transmission of information and managing staff under their authority. Management jobs, where the major emphasis is on broad level decisions on major aspects of company policy, will have rapid access to more and better quality information. Lower level management jobs, where decisions have fewer ramifications, and where many functions revolve around transmitting information up and down the hierarchy and supervising staff and departmental procedures, are likely to face substantial job losses and standardization of work routines. Immediate electronic access to central information reduces the information and decision-channeling functions of many regional offices and departments. Reductions in the number for whom they are responsible and standardization of work and lower level decision processes, decrease the need for managerial oversight. The control, in instruction and error procedures, written into many programmes for non-specialist direct-access users, reinforce the tendency to replace human supervision by machine supervision. Reduction of human supervision has already been experienced by some staff working in direct access to stock handling systems and word processing." (APEX, 1980: 32)

With regard to clerical workers, the introduction of word processors into the office has and will continue to have an impact on the careers of these workers. For example, in order to maximize the use of word processors, clerical workers are often

regrouped into a clerical pool. This has the consequence of lessening the visibility of individual clerical workers to management. Excellent text editors may never receive recognition especially since speed and accuracy are less important when using a word processor than when using an electric typewriter. Also, administrative abilities are difficult for managers to detect when clerical workers are shunted off into a separate location in the office and when there are few opportunities available to word processing clerks to demonstrate their wide range of talents and administrative expertise. However, this is not to say that those clerical workers who choose to work with word processors will not derive benefits from learning computer-related skills. Such skills will likely enable individuals to advance more rapidly in their careers than if they had remained in a traditional clerical position. The skills used in operating a word processor can be translated into higher paying and more responsible functions such as that of retrieving information from the computer and preparing reports for management.

A separate career path which has become increasingly available to clerical workers is one associated with administration. Since, in the future, administrative secretaries will be almost entirely relieved of typing duties by computer technology they will have more time to devote to a wider range of managerial tasks.

The introduction of microelectronic technology into the office may provide clerical workers with the opportunity to make more effective use of their talents, training, and expertise. Associated benefits may include increased income opportunities and job enrichment. There is every reason to expect, however, that with the introduction of this new technology into the office, the traditional work functions and career options of clerical workers will be radically altered. Career options for clerical workers in the future will revolve around: (1) learning a computer-related skill; (2) improving administrative skills and assuming more responsibility, or; (3) exploring the feasibility of training for a totally different kind of career.

While the nature and extent of structural change will no doubt vary by industry and size of firm, it has been suggested that there may be a general trend toward a bifurcation of career ladders: ladders for the small elite of managers making decisions on the basis of the massive data contained in computers, and ladders for the mass of workers employed in entering, manipulating, and retrieving such data from the computer. Little opportunity for mobility between the two classes of workers is foreseen. Given the high level of educational attainment of the "baby boom" cohort, as compared to previous age cohorts, such impediments to career advancement, and hence better paying jobs, may well contribute to labour unrest.

II. Employment Adjustment Policies

While there is generally no consensus in the debate as to the magnitude of the impact of microelectronic technology on the level of employment of office workers there is a consensus that there will be changes in the nature of work functions. As a consequence, there is expected to be a need for policies directed at the retraining or upgrading of the skills of employees. In addition, structural factors associated with the advancement of microelectronic technology in the industrial work environment will likely induce some degree of unemployment.

Problems related to unemployment and labour dislocation, resulting from technological change, require a reassessment of employment policies, employment adjustment policies, labour relation practices, and labour legislation. The latter two issues are currently under review by Labour Canada, with a view to possible amendment of the Canada Labour Code. This section of the paper will therefore address itself to employment and employment adjustment policies.

CEIC has many employment adjustment policies and programs including training programs, geographical mobility, assistance programs, Manpower Consultative Service, unemployment insurance, and employment services programs. However, these programs

and policies must now be reassessed in light of the changing needs of workers and industry as a consequence of relatively recent advances in the introduction of microelectronic technology into the industrial work environment. For example, one issue to consider include providing income support to older workers who might have a difficult time finding new employment if they lose their jobs due to technological change.

The question to be addressed by CEIC is whether current employment programs and policies are adequate in the context of the microelectronics revolution. Recent comments at a Science Council workshop (1980: 59-60) indicate that there is evidence of some concern on this issue:

"It is true that by international standards, Canada does have a pretty impressive battery of policies and programs. We spend more per capita on training than just about any other country in the world. What is not really quite so well established is how efficient that battery of policies and programs is. One thing that calls this into question right away is that precisely during the period when expenditures on these types of programs have burgeoned, we find that the amount of unemployment in this country attributable to the so-called cultural factors has actually increased."

"If we can identify where the imbalances are going to be - and judging from what has been said today I am not very confident we can - then the next stage is redeployment. Sure we have a manpower mobility program in this country, but it is rather small in terms of overall expenditure. The number of clients who have been served is rather small and there are some questions about its efficiency as far as the benefit-costs results that I have seen."

"There is a training program and it is enormous. It has traditionally served as many as 300 000 clients per year. But some people would argue that it has tried to do too many things, to serve too many sub-programs. Whether it can be relied upon to do anything about the kind of reskilling that is required as a result of the microelectronics revolution is unclear."

"Of the whole training effort that has been carried on in Canada in the past until very recently, 90 per cent was delivered in institutions, not on the job."

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"Finally, if your adjustments do not work you have to support the unemployed. It is true that we have a very generous program but even in that area there has been some curtailment of generosity."

Existing employment programs and policies must be extensively evaluated to determine their adequacy in meeting the challenge of labour unemployment and dislocation resulting from the impact of microelectronic technology in the industrial workplace.

CONCLUSIONS

The intent of this paper is to identify some of the major issues with which policy makers will have to contend in the next five years. While this statement of the broad issues lacks a detailed explication, this reflects the lack of consensus in the literature and among informed analysts working in the area. This discussion of the broad issues related to the impact of technological change on the office sector raises, however, a number of pressing concerns for policy makers:

1. While the federal government has been increasing the amount of funding to be directed toward the research and development of micro-electronic and communications technology, relatively little funding has been directed toward research policy and program development concerned with the social and economic impacts of this technology. There is an urgent need for funding to be directed to such matters.
2. The economic forecasting models which have been developed to take account of the impact of microelectronic technology

on employment are generally recognized as inadequate. The development of more adequate data bases, as well as forecasting models, must be given a higher priority.

3. There is now and likely will continue to be a shortage of high-level, skilled people in systems, computer design, and sophisticated software development in Canada. Additional resources will need to be directed to appropriate sources in order to rectify this situation if Canada is to remain in a competitive position in the international market.
4. In terms of the anticipated increase in the demand for retraining as a result of technological change, the needs of women merit special attention. Technological change will create a very difficult situation for re-entry women and re-entry training programs for these women should ideally be organized so that women's access to them is maximized to the greatest extent possible. This may require the provision of part-time training programs, work orientation courses to familiarize women with a given work setting, or short internships to help them overcome their lack of confidence or information.
5. Employment counsellors need to be informed with regard to the changing skill requirements for office occupations in order to provide effective career counselling to entrants into the labour market.
6. Due to technological change, initial training and re-entry training will need to place more emphasis on raising the basic level of vocational skills and general education to ensure greater adaptability on the part of new labour force entrants.

7. Employment adjustment policies and programs (e.g. training programs, geographical mobility assistance programs, Manpower Consultative Service, unemployment insurance, and employment services programs) must be assessed in light of the changing needs of workers and industry as a consequence of the relatively recent advances in the introduction of microelectronic technology into the industrial work environment.

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